An International Journal

computers & operations research

and Their Applications to Problems of World Concern

Editor: Samuel J. Raff

List of Contents and Author Index
Volume 23, 1996

PERGAMON

An International Journal

computers & operations research

and Their Application to Problems of World Concern

editor

Samuel J. Raff: *8312 Snug Hill Lane, Potomac, MD 20854, U.S.A.*

editorial advisory board

G. Anandalingam
University of Pennsylvania

Jonathan F. Bard
University of Texas at Austin

Oded Berman
University of Toronto, Canada

Lucio Bianco
University of Rome "Tor Vergata", Italy

Lawrence Bodin
University of Maryland

Israel Borovits
Tel Aviv University, Israel

R. L. Bulfin
Auburn University

Wilfred Candler
World Bank

Tom M. Cavalier
Penn State University

M. L. Chaudhry
Royal Military College of Canada

Sohail S. Chaudhry
Villanova University

T. C. E. Cheng
Hong Kong Polytechnic, Hong Kong

Eng Ung Choo
Simon Fraser University, Canada

Brian Conolly
Cambridge, England

James DeArmon
The Mitre Corporation

Richard F. Deckro
Air Force Institute of Technology

John Dinkel
Texas A&M University

Moshe Dror
University of Arizona

Fred F. Easton
Syracuse University

H. A. Eiselt
University of New Brunswick, Canada

E. A. Elsayed
Rutgers University

James R. Evans
University of Cincinnati

James O. Frendewey
Michigan Technological University

Moshe Friedman
University of Miami

Saul Gass
University of Maryland

Parviz Ghandforoush
Virginia Polytechnic Institute & State University

Jay B. Ghosh
University of Dayton

Bruce Golden
University of Maryland

Jatinder N. D. Gupta
Ball State University

Cengiz Haksever
Rider College

Michael Hanna
University of Houston—Clear Lake

Edward L. Hannan
Husted Hall Albany

Michael Harnett
Kansas State University

John Honig
Bethesda, Md

James P. Ignizio
University of Virginia

Mark H. Karwan
SUNY at Buffalo

N. K. Kwak
St Louis University

Lawrence LaForge
Clemson University

Santi Lahiri
Winchester, Mass.

Judah Lando
ELSCINT Ltd, Israel

Gilbert Laporte
Université de Montréal, Canada

Richard Larson
Massachusetts Institute of Technology

Cecil E. Law
Queens University, Ontario, Canada

Kenneth D. Lawrence
New Jersey Institute of Technology

Sang M. Lee
University of Nebraska

Reuven Levary
St Louis University

Jay Liebowitz
George Washington University

Vahid Lotfi
University of Michigan—Flint

Ben Malakooti
Case Western Reserve University

Khalil Matta
University of Notre Dame

A. Mehrez
Ben-Gurion University of the Negev, Israel

Hani I. Mesak
Louisiana Tech University

John Mittenthal
University of Alabama

Laurence J. Moore
Virginia Polytechnic Institute & State University

Mohamed S. A. Osman
Heliopolis, Cairo, Egypt

Hasan Pirkul
Ohio State University

Gary Reeves
University of South Carolina

Jeffrey Ringuest
Boston College

Mark Schniederjans
University of Nebraska

Anna Sciomachen
University of Milan, Italy

Jati K. Sengupta
University of California

Hanif D. Sherali
Virginia Polytechnic Institute & State University

David K. Smith
University of Exeter, England

Robert T. Sumichrast
Virginia Polytechnic Institute & State University

Bernard W. Taylor III
Virginia Polytechnic Institute & State University

Efraim Turban
California State Long Beach

Rudolph Vetschera
University of Konstanz, Germany

Howard J. Weiss
Temple University

Ue-Pyng Wen
National Tsing Hua University, Taiwan

Douglas J. White
University of Manchester, England

Robert J. Willis
Monash University, Australia

E.P. Winkofsky
Zellerbach A. Mead, Miamisburg

Publishing Office

Elsevier Science Ltd, Bampfylde Street, Exeter EX1 2AH, England [*Tel.* Exeter +44 (0)1392 51558; *Fax* +44 (0)1392 425370].

Production Editors: Deborah Barrett and Linsey Burbery.

Subscription and Advertising Offices

North America: Elsevier Science Inc., 660 White Plains Road, Tarrytown, NY 10591-5153, U.S.A. Rest of the World: Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, England [*Tel.* Oxford +44 (0)1865 843000; *Fax* +44 (0)1865 843010].

Subscription Rates

Annual Institutional Subscription Rates 1996: North, Central and South America, US$1128.00, Rest of the World £709.00. Associated Personal Subscription Rates are available on request for those whose institutions are library subscribers. Sterling prices exclude VAT. Non-VAT registered customers in the European Community will be charged the appropriate VAT in addition to the price listed. Prices include postage and insurance and are subject to change without notice.

Back Issues

Back issues of all previously published volumes are available direct from Elsevier Science Offices (Oxford and New York). Complete volumes and single issues can be purchased for 1991–1995. Earlier issues are available in high quality photo-duplicated copies as complete volumes only.

Frequency: Published monthly.

Copyright © 1996 Elsevier Science Ltd

PERIODICALS POSTAGE PAID AT NEWARK, NJ. *Computers & Operations Research* (ISSN 0305-0548) is published monthly by Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K. The annual subscription in the U.S.A. is $1128.00. *Computers & Operations Research* is distributed by Mercury Airfreight International Ltd, 10 Camptown Road, Irvington, NJ 07111-1105. POSTMASTER: Please send address changes to *Computers & Operations Research*, c/o Elsevier Science Regional Sales Office, Customer Support Department, 655 Avenue of the Americas, New York, NY 10010, U.S.A.

List of Contents

NUMBER 1

Guillermo Gallego and **Ilkyeong Moon**	1	How to avoid stockouts when producing several items on a single facility? What to do if you can't?
James T. Fagan and **James E. Falk**	13	A method of Euclidean centers
Noel Bryson	27	Group decision-making and the Analytic Hierarchy Process: exploring the consensus-relevant information content
Y. Narahari and **L. M. Khan**	37	Performance analysis of scheduling policies in re-entrant manufacturing systems
Eleftherios Iakovou, Chi M. Ip and **Christos Koulamas**	53	Machining economics with phase-type distributed tool lives and periodic maintenance control
Sohail S. Chaudhry, Linda Salchenberger and **Mehdi Beheshtian**	63	A small business inventory DSS: design, development, and implementation issues
Hsu-Shih Shih, Young-Jou Lai and **E. Stanley Lee**	73	Fuzzy approach for multi-level programming problems
Hoong Chuin Lau	93	On the complexity of manpower shift scheduling

NUMBER 2

Michael F. Argüello, Thomas A. Feo and **Olivier Goldschmidt**	103	Randomized methods for the Number Partitioning problem
M. Tamiz, S. J. Mardle and **D. F. Jones**	113	Detecting IIS in infeasible linear programmes using techniques from goal programming
Laura Burke	121	"Conscientious" neural nets for tour construction in the traveling salesman problem: the vigilant net
Susan A. Slotnick and **Thomas E. Morton**	131	Selecting jobs for a heavily loaded shop with lateness penalties
Hussein M. Saber and **A. Ravindran**	141	A partitioning gradient based (PGB) algorithm for solving nonlinear goal programming problems
Houn-Gee Chen and **Diptendu Sinha**	153	An inventory decision support system using the object-oriented approach

Timothy D. Fry, Ronald D. Armstrong, Kenneth Darby-Dowman and **Patrick R. Philipoom** — 171 — A branch and bound procedure to minimize mean absolute lateness on a single processor

Kyösti Tarvainen — 183 — An elimination condition to check the validity of the principle of optimality

Fatin Sezgin — 193 — A random number generator for 16-bit microcomputers

Włodzimierz Ogryczak — 199 — A note on modeling multiple choice requirements for simple mixed integer programming solvers

NUMBER 3

Mark A. Coffin and **Bernard W. Taylor III** — 207 — Multiple criteria R&D project selection and scheduling using fuzzy logic

Hiroaki Sandoh, Hiroyuki Hirakoshi and **Hajime Kawai** — 221 — An optimal time to sleep for an auto-sleep system

Jacques Renaud, Gilbert Laporte and **Fayez F. Boctor** — 229 — A tabu search heuristic for the Multi-Depot Vehicle Routing Problem

Ming-Long Liu and **Nikolaos V. Sahinidis** — 237 — Long range planning in the process industries: a projection approach

Wlodzimierz Szwarc — 255 — The weighted common due date single machine scheduling problem revisited

Cliff T. Ragsdale and **Patrick G. McKeown** — 263 — On solving the continuous data editing problem

Gary M. Thompson — 275 — A simulated-annealing heuristic for shift scheduling using non-continuously available employees

Jong-Soo Kim, Kyu-Chul Shin and **Hyung-Keun Yu** — 289 — Optimal algorithm to determine the spare inventory level for a repairable-item inventory system

Ho Woo Lee, Seung Hyun Yoon and **Soon Seok Lee** — 299 — A continuous approximation for batch arrival queues with threshold

Note

Patricio A. Rojas — 309 — A note about the Abou-El-Ata Model

NUMBER 4

DATA ENVELOPMENT ANALYSIS

Samuel Raff	v	Preface
Cengiz Haksever	vii	Foreword
	ix	Dedication
Donna L. Retzlaff-Roberts	311	Relating discriminant analysis and data envelopment analysis to one another
O. B. Olesen and **N. C. Petersen**	323	A presentation of GAMS for DEA
Sten Thore, Fred Phillips, T. W. Ruefli and **P. Yue**	341	DEA and the management of the product cycle: the U.S. computer industry
Russell G. Thompson, P. S. Dharmapala, Louis J. Rothenberg and **Robert M. Thrall**	357	DEA/AR efficiency and profitability of 14 major oil companies in U.S. exploration and production
H. O. Fried, C. A. K. Lovell and **J. A. Turner**	375	An analysis of the performance of university-affiliated credit unions
Debbie Nash and **Alicia Sterna-Karwat**	385	An application of DEA to measure branch cross selling efficiency
Lennart Hjalmarsson and **James Odeck**	393	Efficiency of trucks in road construction and maintenance: an evaluation with Data Envelopment Analysis
Technical Note		
M. D. Troutt, Arun Rai and **Aimao Zhang**	405	The potential use of DEA for credit applicant acceptance systems
Announcements	I	

NUMBER 5

Qi Hao, Zihou Yang, Dingwei Wang and **Zheng Li**	409	Common due-date determination and sequencing using Tabu Search
Cliff T. Ragsdale and **Gerald W. Shapiro**	419	Incumbent solutions in branch-and-bound algorithms: setting the record straight
Stephen Engel, Clark Jeffries and **Michael Kostreva**	425	Mathematical systems for enhancing diffuse images of point sources
M. Grazia Speranza	433	A heuristic algorithm for a portfolio optimization model applied to the Milan stock market

John K. Karlof and **Wei Wang**	443	Bilevel programming applied to the flow shop scheduling problem
Karl Nachtigali and **Stefan Voget**	453	A genetic algorithm approach to periodic railway synchronization
Richard Marett and **Mike Wright**	465	A comparison of neighborhood search techniques for multi-objective combinatorial problems
Christopher Rose and **Roy D. Yates**	485	Genetic algorithms and call admission to telecommunications networks
Michel Gendreau, Alain Hertz and **Gilbert Laporte**	501	The traveling salesman problem with backhauls
Note		
W. J. Hurley	509	When are we going to change the learning curve lecture?
Corrigendum	513	
Call for Papers	I	

NUMBER 6

ARTIFICIAL INTELLIGENCE, EVOLUTIONARY PROGRAMMING AND OPERATIONS RESEARCH

Samuel Raff	v	Preface
James P. Ignizio and **Laura I. Burke**	vii	Foreword
David W. Coit and **Alice E. Smith**	515	Solving the redundancy allocation problem using a combined neural network/genetic algorithm approach
David B. Fogel and **Lawrence J. Fogel**	527	Using evolutionary programming to schedule tasks on a suite of heterogeneous computers
James P. Ignizio and **James R. Soltys**	535	Simultaneous design and training of ontogenic neural network classifiers
David Levine	547	Application of a hybrid genetic algorithm to airline crew scheduling
Christopher L. Huntley and **Donald E. Brown**	559	Parallel genetic algorithms with local search
Edward A. Rietman, Suresh H. Patel and **Earl R. Lory**	573	Modeling and control of a semiconductor manufacturing process with an automata network: an example in plasma etch processing
Christopher R. Houck, Jeffrey A. Joines and **Michael G. Kay**	587	Comparison of genetic algorithms, random restart and two-opt switching for solving large location–allocation problems

Kate Smith, M. Palaniswami and **M. Krishnamoorthy**	597	A hybrid neural approach to combinatorial optimization
Douglas Wood and **Bhaskar Dasgupta**	611	Classifying trend movements in the MSCI U.S.A. Capital Market Index—a comparison of regression, ARIMA and neural network methods

NUMBER 7

L. Portugal and **J. Júdice**	623	A hybrid algorithm for the solution of a single commodity spatial equilibrium model
Suresh Chand, Rodney Traub and **Reha Uzsoy**	641	An iterative heuristic for the single machine dynamic total completion time scheduling problem
Yi-Chih Hsieh and **Dennis L. Bricker**	653	New infeasible interior-point algorithm based on monomial method
A. Tishler and **S. Lipovetsky**	667	Canonical correlation analyses for three data sets: a unified framework with application to management
Giovanni Cesari	681	Divide and conquer strategies for parallel TSP heuristics
C. E. Kim, Y. J. Ju and **M. Gens**	695	Multilevel fault tree analysis using fuzzy numbers
H. M. Soroush	705	Optimal sequences in stochastic single machine shops
Melissa Bowers, Charles E. Noon and **Benjamin Thomas**	723	A parallel implementation of the TSSP+1 decomposition for the capacity-constrained vehicle routing problem

NUMBER 8

Hwa-Chun Lin and **C. S. Raghavendra**	733	Approximating the mean response time of parallel queues with JSQ policy
P. Patrick Wang	741	Markovian queueing models with periodic-review
Jie Sun and **Jishan Zhu**	755	A predictor-corrector method for extended linear-quadratic programming
Avital Lann and **Gur Mosheiov**	769	Single machine scheduling to minimize the number of early and tardy jobs
Evangelos Triantaphyllou and **Allen L. Soyster**	783	On the minimum number of logical clauses inferred from examples
Oya Icmeli and **Walter O. Rom**	801	Solving the resource constrained project scheduling problem with optimization subroutine library

Janis L. Miller and **Lori S. Franz** 819 A binary-rounding heuristic for multi-period variable-task-duration assignment problems

NUMBER 9

Bajis Dodin 829 Determining the optimal sequences and the distributional properties of their completion times in stochastic flow shops

S. C. Brailsford, P. M. Hubbard, B. M. Smith and **H. P. Williams** 845 Organizing a social event—a difficult problem of combinatorial optimization

Jung-Ug Kim and **Yeong-Dae Kim** 857 Simulated annealing and genetic algorithms for scheduling products with multi-level product structure

Wade D. Cook, John Doyle, Rodney Green and **Moshe Kress** 869 Ranking players in multiple tournaments

Thomas A. Feo, Kishore Sarathy and **John McGahan** 881 A grasp for single machine scheduling with sequence dependent setup costs and linear delay penalties

Richard A. Sandbothe 897 A user interactive heuristic procedure for solving the multiple product cycling problem

Call for Papers I

NUMBER 10

Ali Allahverdi 909 Two-machine proportionate flowshop scheduling with breakdowns to minimize maximum lateness

A. Volgenant 917 Linear and semi-assignment problems: a core oriented approach

Louis W. Glorfeld and **Bill C. Hardgrave** 933 An improved method for developing neural networks: the case of evaluating commercial loan creditworthiness

Christos P. Koulamas 945 Scheduling two parallel semiautomatic machines to minimize machine interference

Jae Chul Choi and **Dennis L. Bricker** 957 Effectiveness of a geometric programming algorithm for optimization of machining economics models

Maurício Figueiredo and **Fernando Gomide** 963 Regular policies and stability of dynamic scheduling for manufacturing systems

P. Patrick Wang, William J. Gray and Meckinley Scott 981 Quality-related measures of unreliable machines with preventive maintenance

Wen-Hwa Yang and Ching-Jong Liao 997 Group scheduling on two cells with intercell movement

Hani I. Mesak 1007 Incorporating price, advertising and distribution in diffusion models of innovation: some theoretical and empirical results

Call for Papers I

NUMBER 11

Kaushal Chari 1025 Resource allocation and capacity assignment in distributed systems

Sam R. Thangiah, Jean-Yves Potvin and Tong Sun 1043 Heuristic approaches to vehicle routing with backhauls and time windows

Jack A. A. van der Veen and Shuzhong Zhang 1059 Low-complexity algorithms for sequencing jobs with a fixed number of job-classes

Selcuk Avci and M. Selim Akturk 1069 Tool magazine arrangement and operations sequencing on CNC machines

Dennis F. X. Mathaisel 1083 Decision support for airline system operations control and irregular operations

Antonio Frangioni 1099 Solving semidefinite quadratic problems within nonsmooth optimization algorithms

Call for Papers I

NUMBER 12

Thomas Kämpke 1119 Sensitivity analysis for assessing preferentially independent order relations

Yeo Keun Kim, Chul Ju Hyun and Yeongho Kim 1131 Sequencing in mixed model assembly lines: a genetic algorithm approach

Mehran Hojati 1147 Optimal political districting

Kin-Nam Lau, Cheng-Hong Yang and Gerald V. Post 1163 Stochastic preference modeling within a switching regression framework

Kim Allan Anderson, Kurt Jörnsten and Mikael Lind 1171 On bicriterion minimal spanning trees: an approximation

Sri V. Sridharan and **Zhouqun Zhou**	1183	Dynamic non-preemptive single machine scheduling
Antonie Stam, Minghe Sun and **Marc Haines**	1191	Artificial neural network representations for hierarchical preference structures
Yonah Wilamowsky, Sheldon Epstein and **Bernard Dickman**	1203	Optimal common due-date with completion time tolerance
Moncer Hariga	1211	Lot-sizing heuristics for continuous time-varying demand and shortages